APPENDIX C

NOISE AND AIR QUALITY ANALYSES

AIR QUALITY TECHNICAL ANALYSIS

1.0 Introduction

A microscale modeling study was conducted to address the mobile source air quality effect of the Marion Road Trunk Sanitary Sewer Project hypothetical development scenario on the intersection of TH 14 and Marion Road. A mobile source microscale analysis focuses on the impacts of motor vehicles at intersections. This analysis considers carbon monoxide (CO). Since CO is emitted at greater levels during the idle mode, and acceleration and deceleration modes, CO concentrations are generally highest around intersections. Microscale looks at a smaller area of impact (the interesection), as opposed to a mesoscale analysis which focuses on the emisions of motor vehicle over a much larger area. The study was designed to evaluate concentrations of carbon monoxide CO near this intersection for comparison to state and federal air quality standards. The study was conducted to evaluate the effect of project area traffic on CO concentrations at sensitive receptors, both with (build case) and without (no build case) the implementation of the hypothetical development scenario.

The study was based on model inputs provided by the Minnestoa Pollution Control Agency (MPCA).[1]

2.0 Microscale Analysis

The objective of this analysis was to determine if the development associated with the Marion Road Trunk Sanitary Sewer Project hypothetical development scenario will cause or increase predicted exceedances of the Minnesota and National Ambient Air Quality Standards for carbon monoxide. CO is used to indicate roadway air pollutant levels since it is the most abundant pollutant emitted by motor vehicles and can result in "hot spot" locations around congested intersections. The federal primary CO standards, designed to protect the public health, set a maximum concentration of 35 parts per million (ppm) for a one-hour period and 9 ppm for eight hours, each not to be exceeded more than once per year. The State of Minnesota sets a more stringent one-hour level of 30 ppm and maintains the federal eight-hour standard of 9 ppm.

As noted above, the intersection of TH 14 and Marion Road was evaluated. To determine air quality levels, areas of human activity (sensitive receptors) exposed to maximum air pollutant levels from motor vehicle emissions, around this intersection, were identified. Consistent with USEPA Guidelines,[2,5] receptor locations were situated at “sidewalk” locations adjacent to intersection approaches, and where the general public is likely to have access. At these locations, maximum CO concentrations are likely to occur due to vehicles idling, as well as from the acceleration and deceleration of motor vehicles. Using air quality modeling

techniques, the analysis calculated maximum one- and eight-hour CO concentrations at all sensitive receptor locations. The analysis examined the following cases:

Case	Year	Project Status
1	2002	Existing
2	2025	No-Build
3	2025	Build with Mitigation

For each case, the recommended USEPA computer programs MOBILE5b[3] and CAL3QHC[4] were used to calculate CO motor vehicle emissions and concentrations at receptors.

2.1 Motor Vehicle Emissions

Motor vehicle emissions used in the microscale analysis were generated by the USEPA MOBILE5b[3] computer program. MOBILE5b is a computer program that provides emission estimates, including CO, for gasoline-fueled and diesel highway motor vehicles.

Emission estimates depend on various conditions such as ambient temperature, speed, and mileage accrual rates. Modeling incorporated the following MPCA recommended inputs:

- Default Tampering Rates
- Default Vehicle Miles Traveled (VMT) Mix
- Default Mileage Accrual Rates
- State Specific Registration Distribution (1990)
- Default Basic Emission Rates (BERs)
- No Inspection/Maintenance Program
- No Anti-tampering Program
- LAP: ASTM Class: C
- Minimum Daily Temperature of 16°F, Maximum of 38°F
- Use Min/Max Temperature
- Period 1 RVP of 9.0 psi, Period 2 RVP of 9.0 psi
- Period 2 Start Year: 2020
- Ether Blend Market Share and Ether Blend Oxygen Content - 0.000
- Alcohol Blend Market Share - 0.900
- Alcohol Blend Oxygen Content - 0.027

- No Reformulated Gas
- Low Altitude Region
- 20.6% Cold/27.3% Hot Starts
- January 1st Emission Rates
- One Average Speed Per Roadway Link - All Vehicle Types

MOBILE5b model output is included at the end of this appendix.

2.2 Traffic Data

Peak one-hour traffic volumes and turning movements based on the traffic analysis were used to assess one-hour CO concentrations. Free flow roadway speeds utilized in the study were as follows:

Marion Road:	40 mph
TH 14 east of intersection:	55 mph
TH 14 west of intersection:	40 mph

For the peak eight-hour period, roadway concentrations were calculated using an eight-hour to one-hour ratio (or persistence factor) of 0.70 as recommended by the USEPA[2]. This persistence factor accounts for the variability in meteorology over an eight-hour period as compared to one-hour conditions. Eight-hour concentrations were calculated by multiplying predicted one-hour levels by this persistence factor.

2.3 CO Modeling Analysis

The USEPA CAL3QHC[4] computer program was used to predict CO concentrations at sensitive receptor locations around the intersection of TH 14 and Marion Road. The CAL3QHC program utilizes the FHWA CALINE3 line source dispersion model[6] and a routine that internally estimates the length of the queues of vehicles at signalized intersections. CAL3QHC evaluates air pollution concentrations near highways and arterial streets due to emissions from motor vehicles operating under free flow conditions and emissions from idling vehicles from queues at intersections.

CAL3QHC requires input of roadway geometries, receptor locations, meteorological conditions, signal timings, traffic volumes and vehicular emission rates. The following meteorological data and inputs were used:

- P-G Stability Class D
- 1.0 meter per second (m/s) wind speed.
- Wind direction modeled every 10º, from 10º to 360º.

- Mixing Height: 600 meters.
- Deposition/Settling Velocity: 0.0 m/s.
- Surface Roughness (z_o): 108 cm (mostly one to two story structures around intersection).
- Averaging Time: 60 minutes.
- Source Height: 0.3 meters.
- Mixing Zone for Free Flow Links: Width of traffic lanes plus 3 meters (10 feet) on each side.

2.4 Background Air Quality

An air quality analysis also requires an estimate of "background" air quality levels, representing the contribution of all sources in the project area less the specific intersections and parking areas analyzed. Background levels of 3.0 ppm for the peak one-hour and 2.0 ppm for the peak eight-hour were conservatively used for all years.

2.5 Results of Microscale Analysis

Maximum predicted one- and eight-hour CO concentrations at sensitive receptor locations for each modeled scenario are presented in Table 1. These values represent highest expected concentrations as they are predicted during the simultaneous occurrence of defined "worst-case" meteorology and peak traffic conditions. Total concentration results are based on the contribution from the intersection studied and background CO levels.

Following USEPA guidance receptors were located 3 meters laterally from each roadway, as “sidewalk” receptors; and then positioned at 3 meters, 25 meters, 50 meters, and 75 meters from the intersection along the “sidewalk”. An additional receptor was also located at 100 meters along the “sidewalk” for the eastbound and westbound approaches (along TH 14). Eight to nine receptors were located as “sidewalk” receptors in each of the four quadrants directly adjacent to the intersection; for a total of 33 receptor locations. For receptors further from the intersection, CO concentrations are expected to fall off.

The results in Table 1 show that there were no exceedances of either the one-hour (30 ppm state and 35 ppm federal) or eight-hour (9 ppm both state and federal) CO standards for any case. Maximum one-hour and eight-hour concentrations of 9.7 ppm and 6.7 ppm, respectively, were predicted at receptor R22 for the no build case. Receptor R22 is located along the south side of the TH 14 eastbound approach, about 165 feet west of Marion Road.

Detailed discussion of concentrations around the intersection of TH 14 and Marion Road is provided in the AUAR text.Table 1 - Maximum Predicted Ambient CO Concentrations (ppm) at TH 14/Marion Intersection.

TABLE 1

MAXIMUM PREDICTED AMBIENT CO CONCENTRATIONS 9PPM0 AT TH 14/MARION INTERSECTION
Marion Road Trunk Sanitary Sewer Project AUAR

Intersection	Receptor	Existing		2025 No Build		2025 Build w/Mitigation	
		l-Hr	8-Hr	1-Hr	8-Hr	1-Hr	8-Hr
TH 14 at Marion Road	R1	5.9	4.0	6.4	4.4	6.4	4.4
	R2	6.3	4.3	6.8	4.7	7.2	4.9
	R3	6.9	4.7	7.0	4.8	8.4	5.8
	R4	5.9	4.0	6.6	4.5	7.1	4.9
	R5	8.2	5.6	8.3	5.7	10.2	7.0
	R6	7.6	5.2	7.8	5.4	8.4	5.8
	R7	5.7	3.9	7.5	5.2	7.4	5.1
	R8	5.0	3.4	6.1	4.2	5.9	4.0
	R9	5.1	3.5	6.1	4.2	6.1	4.2
	R10	5.7	3.9	6.4	4.4	6.7	4.6
	R11	5.5	3.8	6.1	4.2	6.9	4.7
	R12	6.0	4.1	6.6	4.5	7.2	4.9
	R13	7.1	4.9	7.4	5.1	9.9	6.8
	R14	6.3	4.3	6.9	4.7	9.2	6.3
	R15	5.2	3.5	6.4	4.4	8.1	5.6
	R16	4.7	3.2	6.0	4.1	7.3	5.0
	R17	5.4	3.7	6.2	4.2	6.8	4.7
	R18	6.2	4.2	6.6	4.5	8.0	5.5
	R19	6.1	4.2	6.4	4.4	7.6	5.2
	R20	6.9	4.7	7.7	5.3	7.8	5.4
	R21	9.1	6.3	9.2	6.3	10.2	7.0
	R22	**9.7**	**6.7**	9.1	6.3	**10.3**	**7.1**
	R23	8.0	5.5	**9.5**	**6.6**	9.9	6.8
	R24	5.7	3.9	7.5	5.2	8.5	5.9
	R25	5.3	3.6	6.4	4.4	6.7	4.6
	R26	5.9	4.0	6.4	4.4	7.1	4.9
	R27	5.9	4.0	6.0	4.1	7.4	5.1
	R28	5.7	3.9	5.9	4.0	6.8	4.7
	R29	7.0	4.8	7.3	5.0	8.3	5.7
	R30	7.8	5.4	8.1	5.6	8.4	5.8
	R31	6.0	4.1	7.8	5.4	7.8	5.4
	R32	5.3	3.6	6.6	4.5	9.1	6.3
	R33	4.8	3.3	6.1	4.2	8.6	5.9

Note: Bold text indicates maximum one-hour and eight-hour concentrations.

REFERENCES

1. Personal Communication, Mr. Innocent Eyoh, MPCA, 02/27/2002 and 02/28/2002.

2. USEPA, *Guideline for Modeling Carbon Monoxide from Roadway Intersections*, EPA-454/R-92-005, November, 1992.

3. USEPA, *User's Guide to MOBILE5 (Mobile Source Emissions Factor Model),* May, 1994.

4. USEPA, *User's Guide to CAL3QHC, Version 2.0: A Modeling Methodology For Predicting Pollutant Concentrations Near Roadway Intersections*, EPA-454/R-92-006, Revised, September, 1995.

5. USEPA, *Guideline for Air Quality Maintenance Planning and Analysis Volume 9 (Revised); Evaluating Indirect Sources*, USEPA-450/4-78-001, September, 1978.

6. Benson, P., *CALINE3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets*, FHWA/CA/TL-79/23, November, 1979.

VEHICLE RELATED NOISE TECHNICAL ANALYSIS

Two roadway sections were evaluated for vehicle-related noise. The first roadway is 40th Avenue from TH 14 to Eastwood Road and the second is Eastwood Road, just east of Marion Road. These two roadways were selected because they are predicted to carry the highest traffic increase in areas of primarily residential land use in the project area and, therefore, could experience the most perceptible traffic noise increase related to sensitive receptors. Graphs showing the future sound levels at varying distances from two roadways are attached to this report.

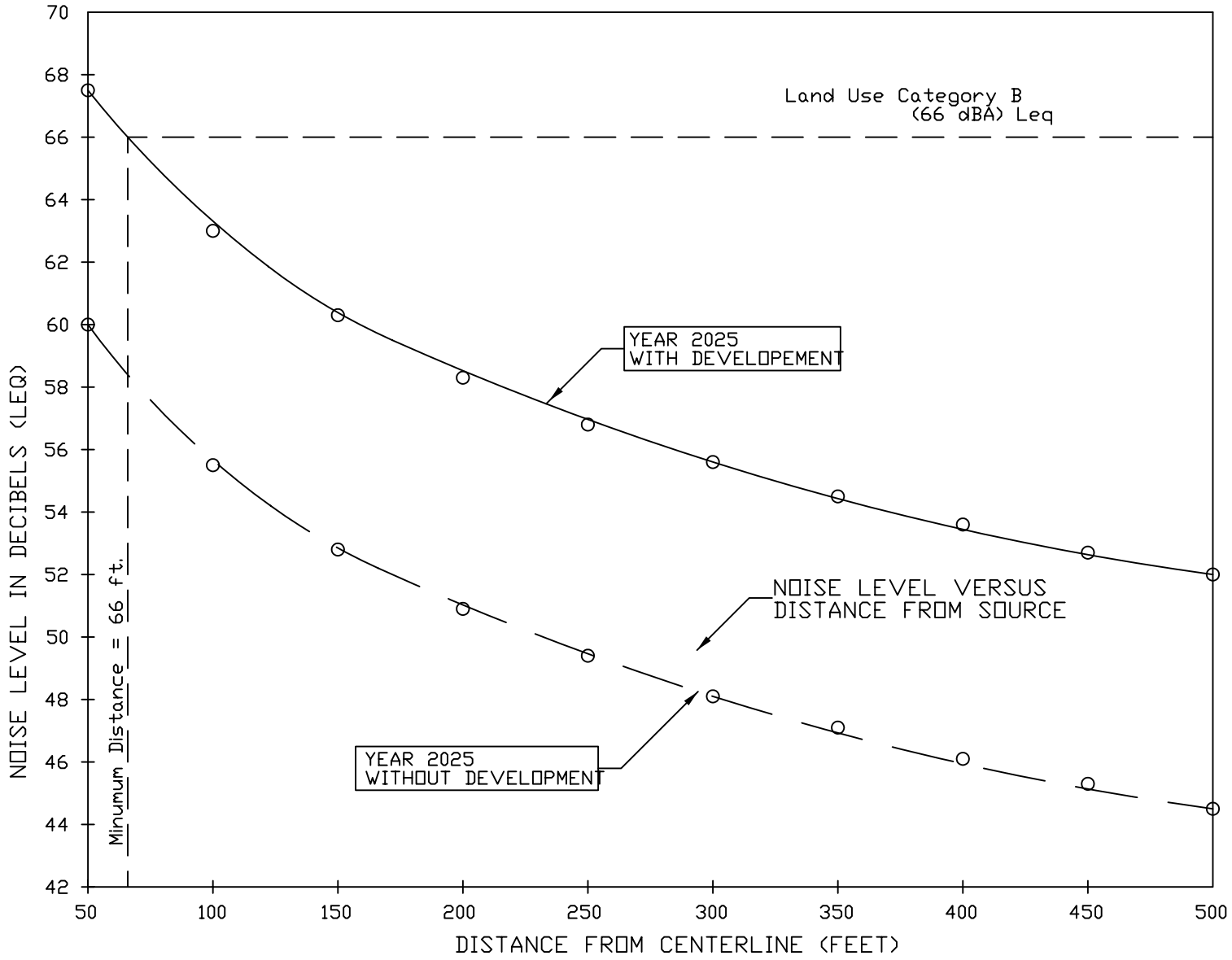
The design hour traffic volumes for the year 2025 were used to predict these sound levels. The graphs depict noise level versus distance from the median centerline of a roadway. Two types of noise abatement criteria were evaluated. A dBA is a unit of measure of sound level. The number of decibels is calculated as ten times the base-10 logarithm of the square of the ratio of the mean-square sound pressure (often referred to as frequency weighted), and the reference mean-square sound pressure of 20 μPa, the threshold of human hearing. The A-weighting network de-emphasizes the high (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of the human ear. The Federal Highway Administration (FHWA) adopted a sound level of 67 dBA, LEQ, for residential areas and 72 dBA, LEQ, for commercial/industrial areas. LEQ is the equivalent steady-state sound level that in a stated period of time contains the same acoustic energy as a time-varying sound level during the same period. Minnesota has adopted daytime sound levels of 65 dBA L_{10} for classification 1 areas and 70 dBA L_{10} for classification 2 areas. The L_{10} is the sound level exceeded 10 percent of a specific time period. In general, Minnesota's noise abatement criteria are more stringent than FHWA's. Any location along a roadway capacity improvement project that approaches or exceeds these thresholds should be investigated for feasible and reasonable noise abatement measures in the development of the project.

Table 1 summarizes the minimum recommended distances from the centerline of a roadway to any residential receptor to be below the noise abatement criteria. Currently, all residences and businesses are outside the minimum distance from the centerline of 40th Avenue and will be in compliance with federal and state noise abatement requirements. However, Eastwood Road just east of Marion Road has a businesses and several residences within the minimum distance from the centerline of Eastwood Road that are currently out of compliance with federal and state residential noise requirements. These businesses and residences will continue to be out of compliance with higher traffic levels that will occur as development in the area occurs. Noise walls are sometimes considered as mitigation when numerous structures are affected. In urban areas noise walls are typically not practical due to the need of the affected property to maintain access points from the main roadway. Therefore, no mitigation is recommended for these structures.

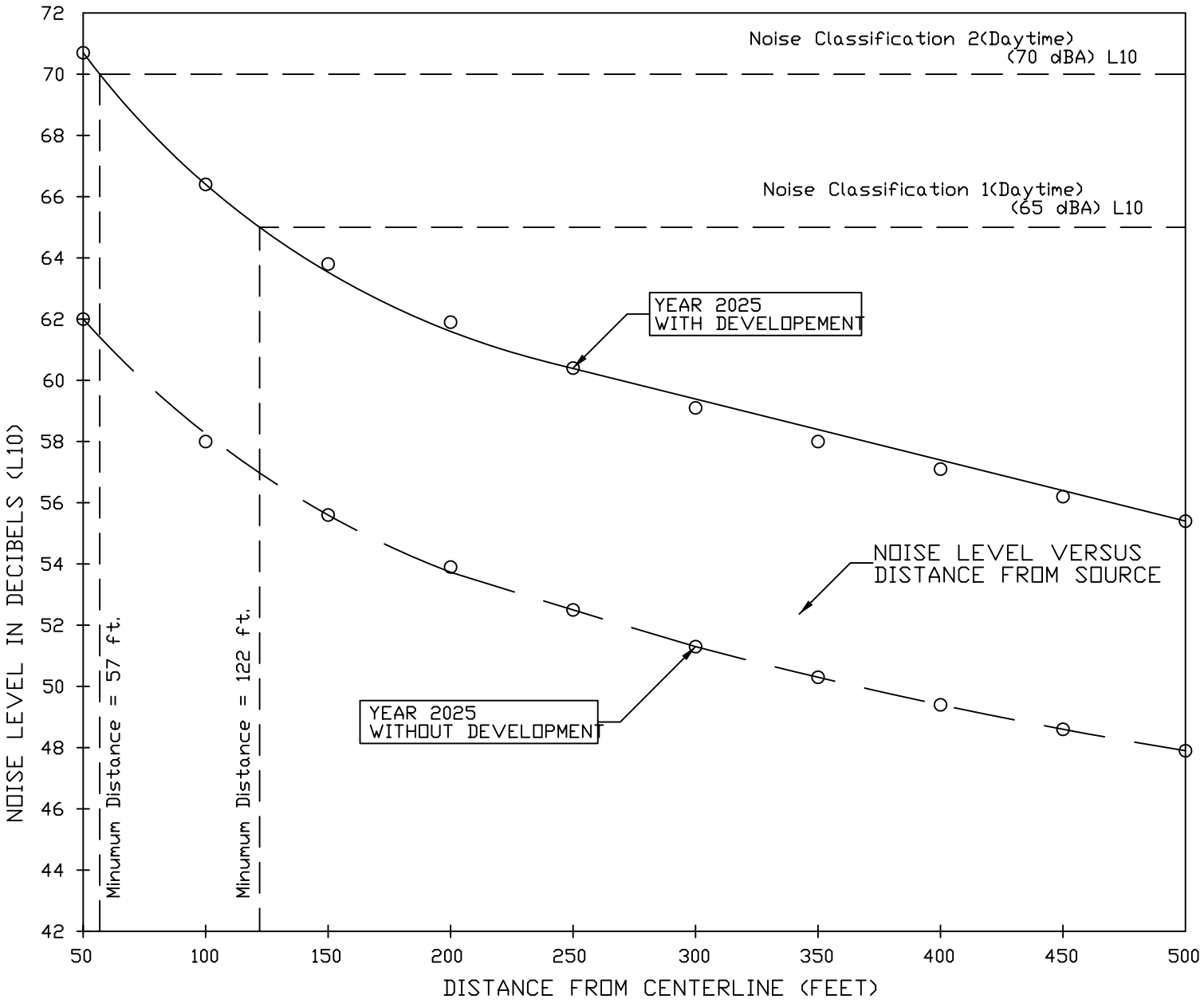
TABLE 1

TRAFFIC NOISE SUMMARY TABLE
Marion Road Trunk Sanitary Sewer Project AUAR

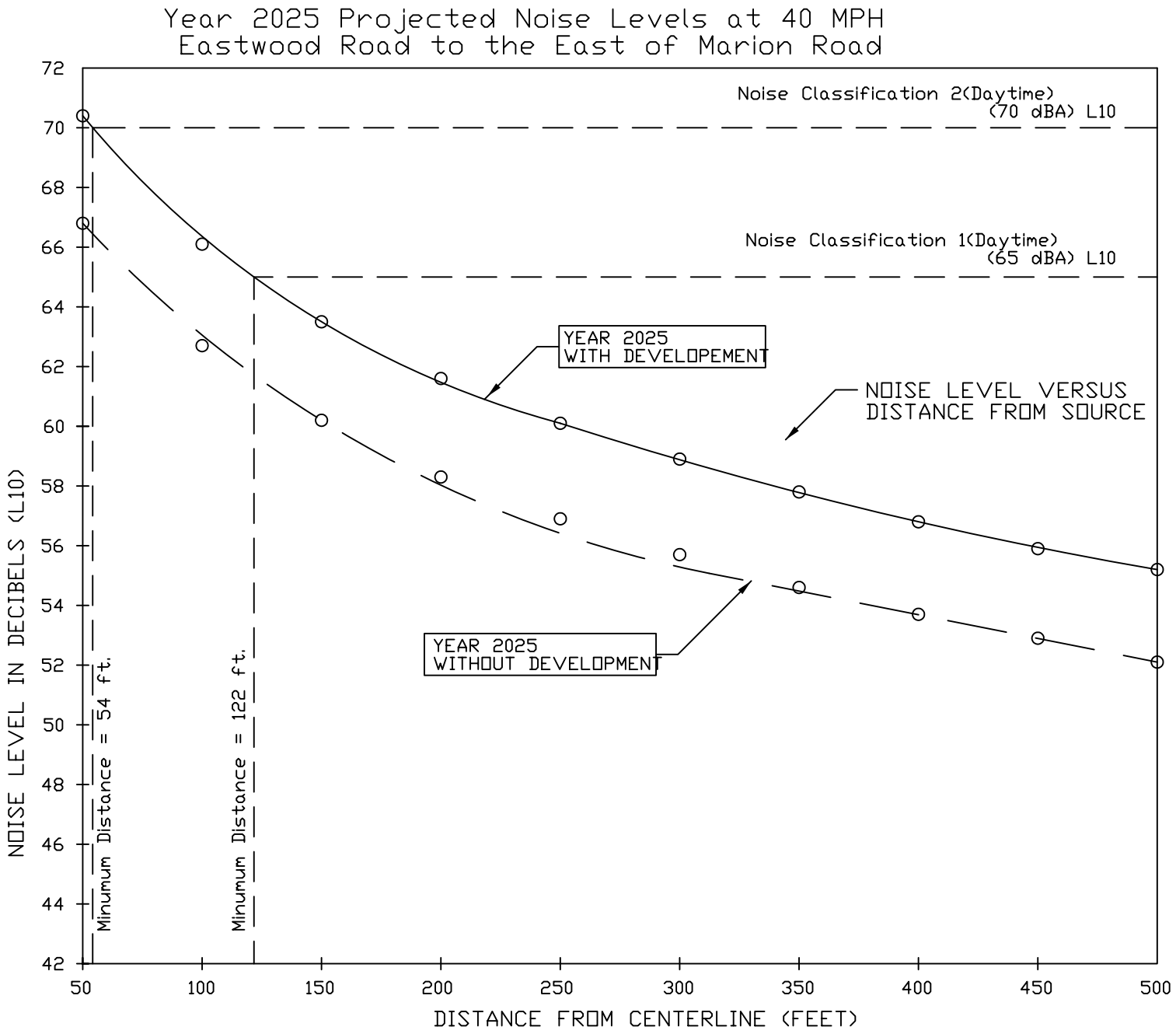
Noise Abatement Categories	Noise Abatement Criteria	Minimum Distance from Centerline of Road that Residential Noise Criteria are Met	
		40^{th} Avenue	Eastwood Road
Federal - Land Use Category B	67 dBA (Leq)	66 ft.	62 ft.
Minnesota - Classification 1 (Daytime)	65 dBA (L_{10})	122 ft.	122 ft.
Minnesota – Classification 2 (Daytime)	70 dBA (L_{10})	57 ft.	54 ft.



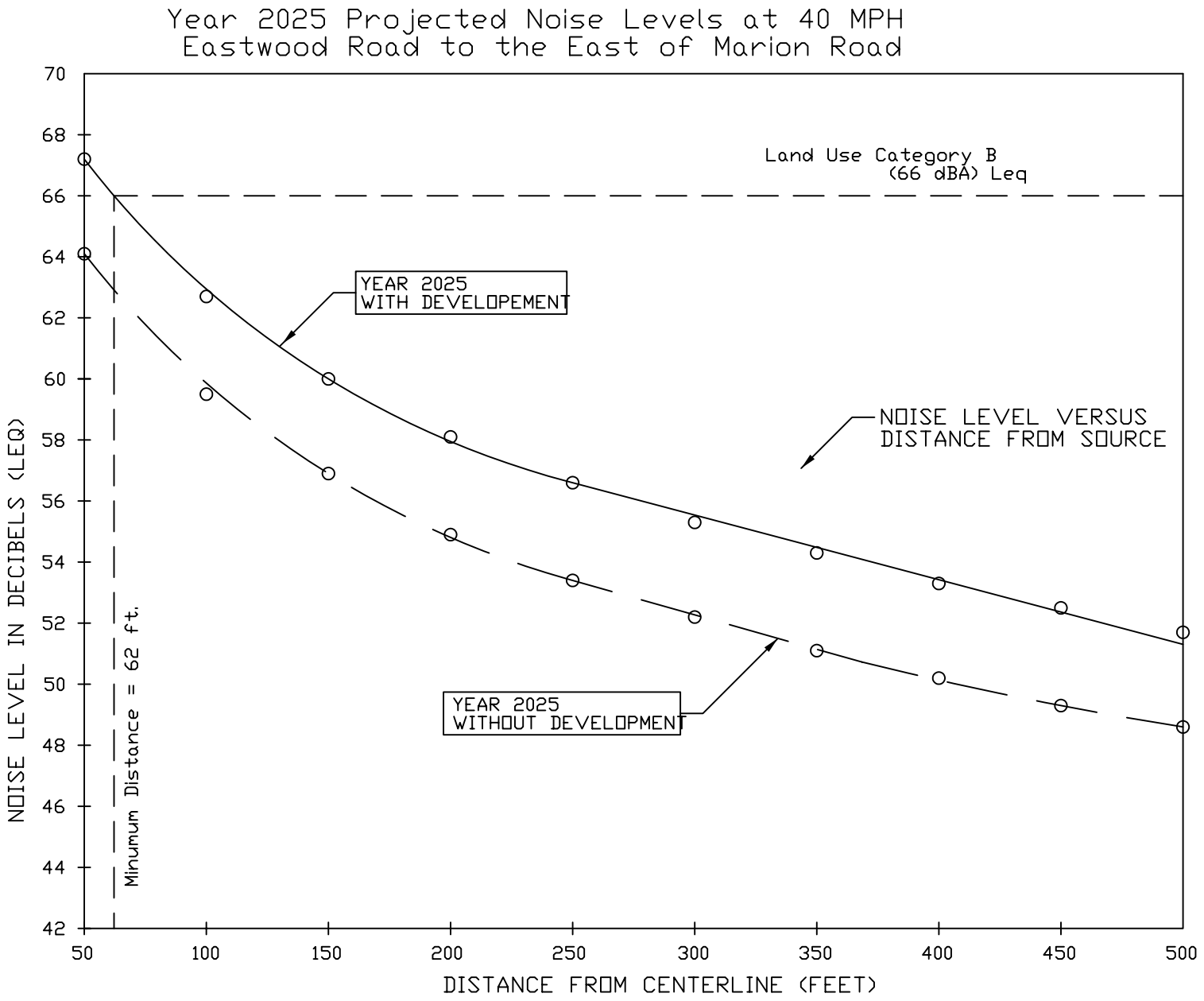
MARION ROAD TRUNK SANITARY SEWER AUAR
NOISE ANALYSIS
FEDERAL ABATEMENT CRITERIA



MARION ROAD TRUNK SANITARY SEWER AUAR
NOISE ANALYSIS
MINNESOTA ABATEMENT CRITERIA



MARION ROAD TRUNK SANITARY SEWER AUAR
NOISE ANALYSIS
MINNESOTA ABATEMENT CRITERIA



MARION ROAD TRUNK SANITARY SEWER AUAR
NOISE ANALYSIS
FEDERAL ABATEMENT CRITERIA